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A PRELIMINARY LIST OF INVERTEBRATES, PARASITIC OR OTHERWISE NOXIOUS TO MAN, COLLECTED IN PORTUGUESE WEST AFRICA: 1904-1906

BY F. CREIGHTON WELLMAN

It has seemed to the writer that a tentative list of the animal parasites and other allied enemies of man thus far encountered in what is as yet almost virgin territory to scientists ought to be of interest to those concerned with microbiology and the geographical distribution of parasitic disease. I have accordingly gone over my small collection of the fauna of the Angola highlands (consisting of about 700 species) and prepared the following list of Protozoa, Vermes and Arthropoda which are noxious to man—using the term, *sensu generali,* to denote any invertebrate animal which may be inimical during any stage in its life history to the health or comfort of human beings. Speaking strictly from the academic point of view some of the worms and arthropods mentioned are not microscopic. However if the worms are not microscopic their ova (upon the detection of which generally depends the diagnosis of the adults' presence) certainly are, and while the insects, etc., are macroscopic in size (as every entomologist knows) few of them can be specifically determined with the naked eye alone. So, even if I did not know of the highly laudable interest taken by this society in practical parasitology, I should not feel that I were forcing a personal hobby upon your attention. Writing purely as a microscopist, I have not discussed the symptoms and pathology of the diseases subtended by the various organisms mentioned, and indeed space considerations have made it possible for me to transcribe only the briefest possible extracts from my notes on morphology and bionomics. I have included an insect and a mite (marked in the list by asterisks) which are only suspected of possibly playing a mischievous role in their larval stage. I have considered more than the occasional mention of related parasites of animals which are common or of peculiar interest, as lying without the scope of this report.

PROTOZOA

Rhizopoda

Entamoeba histolytica Sch. What I have referred to this species is not seldom seen. It is not, however, always found in connection with dysentery, but can occasionally be demonstrated in the faeces of apparently healthy natives. The organism is somewhat larger than is usually stated for this species and measures 0.007—0.01 mm. in diameter. The closely allied *E. coli* Lösch can be certainly differentiated from the foregoing only by a study of their pathological effects. What I suspect to be another and much smaller species than either of these is more rarely seen. An allied form is also found in the intestines of pigs. Charcot-Leyden's crystals are often seen in mucous containing such organisms.

Mastigophora

Trichomonas sp. Seen in intestinal mucous of a child with slight diarrhoea; measures about 0.02 x 0.01 mm. Three flagella.

Cercomonas sp. (? *hominis* Dav.). These spermatozoa-like organisms were also from a case of diarrhoea. Body measures about 0.01 mm. and flagellum about 0.02 mm. in length.

Trypanosoma gambiense Dutt. My specimens from cases of human trypanosomiasis seem to be morphologically identical with Dutton's published descriptions. The posterior end is truncated and the arrangement of the centrosome, nucleus, and flagellum, as well as the "set" of the organism on the slide correspond with the same points in *gambiense*. The protoplasm stains somewhat irregularly with Romanowsky stain, taking on a basophile reaction. The centrosome stains a dark purple hue and the flagellum (which stains pink) seems to rise from or near it. The nucleus lies near the middle of the body and often occupies more than two-thirds the width of the parasite. It is oval in shape and stains red like other chromatin material. Following are measurements of a stained specimen:

Length	(about)	24 μ
Greatest width		3.5 μ
Distance of centrosome from posterior end		3 μ
Length of free flagellum	(about)	9 μ
Length of diameter of nucleus		4 μ

I have also found several animal trypanosomes which may be mentioned here.

Trypanosoma avium Dan. Found in blood of a wild dove, *Treron calva.* Plump, fish-shaped, with the posterior end rather sharp. Faint longitudinal striae or myonema lines can be made out in the protoplasm as well as very fine granules. The nucleus extends about two-thirds across the body and seems to almost completely fill the space in which it lies. The flagellum and undulating membrane are wavy in very regular curves. The free flagellum is comparatively short. Following are the principal measurements of a stained specimen:

Length		28 μ
Greatest width		9 μ
Distance of centrosome to posterior end		4 μ
Length of free flagellum	(about)	8 μ
Longest diameter of nucleus		6 μ

Trypanosoma lewisi Kent. From rat (*Mus decumanus*). No differences in structure between these and specimens secured by me from sewer rats while I was at the University of London in 1904. The slender contour and narrow undulating membrane are well shown. I give measurements of a stained specimen:

Length		60 μ
Greatest width		2 μ
Distance from centrosome to posterior end		4 μ
Length of free flagellum		10.5 μ
Largest diameter of nucleus	(about)	3 μ

Trypanosoma mega Dutt. et Todd. My specimens from frogs (*Rana tuberculosa*) resemble rather closely the descriptions of this species. The same parasite or a very similar one has been found recently on the Congo. The distinguishing points of this trypanosome are the large size, the longitudinal markings, the great distance of the centrosome from the posterior end, the ill-defined nucleus and the tortuous flagellum. Following are the measurements of a stained specimen:

Length	(about)	60 μ
Greatest width		8 μ
Distance of centrosome from posterior end		17 μ
Length of free flagellum	(about)	18 μ
Largest diameter of nucleus		3.5 μ

Spirochaeta duttoni Novy et Knapp. In including spirochaetes here I do not necessarily imply an opinion as to the protozoal nature of these organisms. The opinions of Schaudinn *et alii* are well known. Still should the bodies turn out (as most investigators now predict) to be schizomycetes, no great harm will be done by recording in a report on animal parasites the occurence of a few species in West Africa. *S. duttoni,* the cause of "tick fever" in Africa, is not uncommon. The writer was among the first (if not the first) to point out that the species can be morphologically distinguished from *S. obermeieri* by the difference in the curves of the two organisms.

Novy and Knapp in differentiating *duttoni* from *obermeieri* adopt this character in the following words: "A further important characteristic is afforded by the width of the turn of the whole spiral. In the case of *S. obermeieri* this width measures quite constantly 1.0 μ, whereas in *S. duttoni* it amounts to 2.0 to 2.7 μ. This fact is referred to by Wellman when he says that the spirillum studied by him in West Africa 'dies in rounder and more flowing curves than are generally described and pictured,' etc., etc."[1]

Spirochaeta pertenuis Cast. While my discovery of spirochaetae in the disease called "yaws" was entirely independent and my preliminary note was on its way to America long before Castellani's announcement reached me, yet I have of course explicitly[2] accorded him priority in the matter since he was the first to publish his observations. It is rather remarkable that the same discovery should be almost simultaneously made in two such widely separated countries as Ceylon and West Central Africa. There are several types of organisms found in the lesions. I think my species from the unulcerated papules are rather closer to the *pallida* type than Castellani's description of his *pertenuis* is.

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[1] Journal of Infectious Diseases, May 18, 1906, p. 382.

[2] *Vide* Journal of Tropical Medicine, Dec. 1, 1905, p. 345; Boston Medical and Surgical Journal, May 3, 1906, p. 489; Archiv für Schiffs-und Tropenhygiene, 1906, p. 727, etc.

Spirochaeta spp. I have announced the demonstration of spirochaetae in a very peculiar and severe marginal ulceration of the gums endemic in Africa and South China. The organism can, I believe, be distinguished from the spirochaetae usually seen in healthy mouths. My investigations of this subject will be published in a short time.

Sporozoa

Haemamoeba vivax Gross. et Fel. Comparatively rare. In a series of 531 blood examinations made in this colony for the Societa per gli Studi della Malaria only 14 individuals were found with quartan parasites.[1] This form of malaria among the blacks is an almost negligible quantity both from its rarity (0.26 per cent) and from the mildness of the symptoms set up. It rarely causes rise of temperature in the native, the schizogenesis of the parasite going serenely on without interfering with the host's health or happiness.

Haemomonas praecox Lav. Very common. In the series of blood examinations just mentioned 285 individuals were found to harbor this species. To this should be added 153 individuals not showing parasites in the blood but whose large mononuclear nuclei formed 20 per cent or more of the whole number. These facts taken with the results of the spleen index of 513 natives, made at the same time, have led me to calculate that about 83 per cent of apparently healthy natives show parasites or other evidence of malaria in their blood and that moderate invasion is almost universal and that at least half the population are heavily infected.

Infusoria

Balantidium sp. An infusorian found in faeces. No symptoms. Measurements: 0.15 mm. x 0.06 mm. Peristome large, ectosarc ciliated. Macronucleus round or oval. A similar form is found here in pigs.

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[1] Individuals who were not taking quinine.

VERMES

Trematoda

Paramphistomidae

None of the Paramphistomidae have been seen in human beings although I have frequently found an *Amphistomum* in the stomach of the lesser reed buck (*Cervicapra bohor*).

Fasciolidae

Fasciola hepatica L. var. *angusta* Raill. Several cases seen. This fluke is also common in oxen and antelope of different sorts. Measurements: Average of formalin specimens, 30.5 x 7 mm. Eggs: 0.15 x 0.85 mm.

Schistosomidae

Schistosomum haematobium Bilh. Fairly common. Infections all slight. Ova not very plentiful and lesions insignificant. Ova with side spine from rectum occasionally seen. The differences in the eggs are very striking and suggest different species.

Cestoda

Bothreocephaloidea

Dibothriocephalus latus L. Not seldom seen. Gotten through eating raw fish.

Taeniidae

Hymenolepis sp. One incomplete specimen.

Taenia saginata Goeze. Not very common. More often seen in the interior where beef is more easily obtainable.

Taenia echinococcus v. Lieb. Rare. One case. I have seen the scolices [bladderworms?—Ed.] several times in oxen.

Taenia sp. (nov.). I have been informed that this specimen represents a new species but the description has not yet been published.

Nematoda

Anguillulidae

Gen. et sp. incert. This minute entozoal embryo was found in the blood of a negress and was first mistaken for a filarial embryo. I referred it to Dr. Low and Sir Patrick Manson on the occasion of my last visit to London. They both thought that it probably belongs to the Anguillulidae and that its presence in the blood was doubtless accidental.

Angiostomidae

Strongyloides intestinalis Bavay. Seen several times (the rhabditiform larvae) in faeces, once in connection with a severe diarrhoea. The remarkable heterogenetic reproduction is difficult to see, as the parasitic-living generation does not appear spontaneously in the faeces.

Filariidae

Filaria perstans Mans. Not common. About one native out of every hundred infected. I have been working for about two years on the life history. Although my investigation is not complete I have succeeded in proving certain points of interest. [Some slides illustrating which were exhibited at the meeting.—Ed.] The presence of the parasite causes no symptoms.

F. nocturna Mans. Very rare in the highlands. Common in the littoral zone where elephantiasis abounds.

Filaria sp. One solitary embryo in the urine of a Bantu man. Sheathless and sharp-tailed. Much smaller than *F. demarquayi.*

Trichotrachelidae

Trichocephalus trichiuris L. Rare; two cases. The characteristic ova (like an oval tray with handles at the ends) measure about 0.05 x 0.22 mm. No symptoms.

Strongylidae

Strongylus spp. I have not yet found any of these forms in man but a large number infest animals (*e. g., Strongylus contortus* in goats). I have also found an undescribed species of *Cylichnostomum* frequent in the same host.

Ankylostomum duodenale Dub. Very common in some districts; 13 infections out of 310 random faeces examinations from different parts of the country.

Ascaridae

Ascaris lumbricoides L. Found in 158 infections out of 310 routine faeces examinations. Almost universal in children. Sometimes occurs in enormous numbers. I have seen 96 worms passed by a child two years old the result of a single dose of castor oil and santonin.

Ascaris lumbricoides var *X*. In February, 1904, I described some very peculiar ova from a variety of *Ascaris* infesting a white child then resident in this colony. These were bean-shaped, with an opaque, rugose, albuminous envelope. There were also some anatomical peculiarities of the adult worm that led me to suspect that I was dealing with an instance of variation, or possibly even a new species. Quite recently I see that O. T. Logan of China states that he has found the same type of eggs from adults that show some of the same peculiarities mentioned by me in my original note. Dr. Logan refers to the correspondence between his observations and mine and asks if we are dealing with a new species. I should like to see the question settled and propose to place some specimens in Dr. Ward's hands soon for examination.

Oxyuris vermicularis L. Common in children.

Gordius sp. This is not a human parasite but a very interesting worm which in its larval stages infects the migratory locust (*Schistocera peregrinatoria*). Free living in its adult age. The blacks believe it invades human beings.

Hirudinei

?Hirudo sp. Found clinging to a native porter after having crossed a marsh. I found another species in a plain half a mile from the nearest water. The report on these leeches (which were sent to Paris for determination) has not yet been received.

ARTHROPODA

Arachnida

Scorpionida, Araneida

Several scorpions and spiders which have not yet been reported on have poisonous bites. Among the latter are a tarantula and a large species of *Nephila*. A huge pedipalp is also feared by the natives but is probably harmless.

Acarina

Trombidiidae

**Trombidium grandissimum*. In native camps. I have found a larval mite which bites like *Leptus autumnalis*. I suspect the adult may be the large red mite above named. It is predatory in its habits.

Ixodidae

Rhipicephalus decoloratus Koch. Found on cattle and other domestic animals.

Amblyomma varigatum Fabr. Cattle, etc. I have never seen these ticks listed as parasites of man but they readily bite human beings. I have personally been victimized by *A. variegatum.*

Ornithodoros moubata Murr. Usually known as *O. savignyi* Aud. var. *caeca* Neum., but the name I have given is the earliest one given the tick and Dr. Nuttall of Cambridge writes me that he will use it in the new monograph of ticks. Very common. Within an hour's time I have found as many as a hundred in an old native hut. Hides by day in thatch, walls, etc., and comes out at night to bite. Bites man and all domestic animals. Is the disseminator of *Spirochaeta duttoni* and probably an officient for *Filaria perstans.* [Preparations of this tick fed on *perstans* cases were exhibited at the meeting.—Ed.]

Sarcoptes scabei L. Common. Also other varieties on animals.

Myriapoda

A number of venomous centipedes are common. Two different genera of Julidae (millipedes) are remarkable for causing intense smarting and burning when they crawl on the body. Their poisonous secretion is probably from the foramina repugnatoria which are in the sides of the segments and look like tracheal stigmata. The real stigmata are on the ventral surface of the segments and so minute as to be easily overlooked. These millipedes belong to the genera *Spirostreptus* and *Odontopyge.*

INSECTA

Orthoptera

There are several grasshoppers (*Phymateus, Pamphagus,* etc.) which defend themselves by means of a stinking secretion which is, however, nothing more than unpleasant to the nostrils. Three species of giant earwigs can draw a large drop of blood with their pincers and one so frequently introduces septic matter in this way, that the natives greatly fear it and believe it to be venomous. These species are *Apachys chartacea* Pal.-Beauv., *A. reichardi* Karsch, and a third representing a new genus and species which will soon be described.

Hemiptera

Reduviidae

Several species that bite man have been collected. The most interesting of these is *Phonergates bicoloripes Stal,* which also habitually mulcts *Ornithodoros moubata* (*vide supra*) of its ingested blood.

Acanthiadae

Clinocoris lectularius Wer. Common.

?Cimex sp. A large bug which has not yet been determined.

Pediculidae

Pediculus capitis de Geer. Universal among natives.

P. vestimenti Nitzsch. Very common. *Phthirius pubis* has not yet been seen.

Lepidoptera

The larvae of a number of these insects defend themselves by means of stinging hairs and bristles. The effect of touching some of these is astonishingly severe, even alarming symptoms being set up. The worst of them belong to three different families, *viz.*, Limacodidae, Arctiidae, and Liparidae (resembles larva of some Tortricidae).

Diptera

Culicidae

I have made a large collection of these. Only the most common can be mentioned here. These are: *Anopheles welcomei* Theob., *Myzomia funesta* Giles, *Pyretophorus austenii* Theob. (nov.), *Myzorhyncus umbrosus* Theob., *Cellia squamosa* Theob., *C. pharoensis* Theob., *Danielsia wellmani* Theob. (nov.), *Culex hersutipalpis* Theob., *C viridis* Theob., *C taeniorhynchoides* Giles (nov.), etc., etc. So much has been written about mosquitoes that I must refrain from discussing their bionomics at this time, excepting to say that *M. funesta* is the great carrier of malaria and that I have found as high as 13 per cent of this species to be infected with malarial parasites. Two new points in morphology are the following:*Heptaphlebomyia simplex* Theob., has hitherto been known only from female specimens, which differ from all other mosquitoes by having a distinct seventh scaled wing vein, upon which character Mr. Theobald has founded a new genus and a new sub-family. From some specimens bred by me and sent to the British Museum last year, however, appears the remarkable fact that the males do not share this peculiarity. In these there is no true scaled seventh vein, but the sixth is bent at right angles near the edge of the wing. A suite of specimens of *C. hirsutipalpis* Theob., also bred from eggs, which I sent to the Museum at the same time, also showed sexual dimorphism (the males having no pole band at the apex of the palpi) besides remarkable variation in size, some being a third smaller than the type.

Chironomidae

Ceratopogon sp. Small sand fly. Very vicious.

Simulidae

Simulium sp. Likewise very vicious.

Tabanidae

Tabanus sp. (near *rubricundus* Walk). Occasionally bites man.

Tabanus sp. (near *latipes* Macq.). Bites animals and man. These two species are probably new.

Tabanus socius Walk. Bites man also.

Haematopota spp. Eight or ten new species which will soon be described. Bite man.

Chrysops spp. Several species. Bite man.

Muscidae

Stomoxys spp. Bite domestic animals and man,

Glossina palpalis wellmani Aust. This is probably the representative of the species in South Africa. *Glossina palpalis palpalis* is not found in this district. *Wellmani* has also been found in central and east Africa, and reports show that it takes the place of *palpalis* (south of 10° S. lat.) to at least 30° E. long. I have elsewhere shown that *wellmani* is the carrier of human trypanosomiasis in my region. Other species (*longipalpis* and *tachinoides*) are found in the northern part of the colony.

Musca domestica L. Sometimes lays eggs in open wounds. This species with *Homalomyia scalaris* and *Pycnosonia chloropyga* are probably the worst bacteria carriers among our local diptera, and are doubtless responsible for much enteric fever and other diseases.

Sarcophagidae

Sarcophaga africa Wied. I have proven this species (and *S. albofasciata* Macq. as well) to be capable of causing severe destructive myasis. I also found larvae living under the skin of man. Dr. L. O. Howard writes as follows concerning a specimen of these latter: "The larva removed with a pair of forceps from under the skin is most interesting. It appears not to be a muscid, but its affiliations are with the Sarcophagidae, the true flesh flies; but I know of no record of the occurrence of the larva of this family under the skin of a human being. Still, new things are coming up all the while, and we may have here something absolutely novel."

Auchmeromyia luteola Fabr. The larva of this fly sucks human blood and is one of the commonest pests of the region. I have elsewhere published a study of its life history.

Anthomyidae

Anthomyia desjardinsii Macq. A case of serious intestinal myasis caused by this fly. A number of the larvae were passed *per rectum.* I am not aware of this species having been previously convicted of causing myasis.

**Hylemyia fasciata* Walk. A case of maggots infesting a wound is possibly due to this fly. The larvae were not bred out, however, as they were in my other cases of myasis.

Hippoboscidae

Hippobosca sp. (*rufipes* Th.). Not very common. Oftenest seen on donkeys. Sometimes attacks man.

Siphonoptera

Pulex irritans L. Not very common.

Pulex cheopis Roth. Commonest flea on rats, etc. Bites man.

Pulex spp. Several species of fleas sent to London have not yet been heard from.

Ceratophyllus fasciatus Bosc. Dogs, etc. Bites man.

Sarcopsylla penetrans L. Universal throughout the region. Lives in dust, etc., in old kraals and camps. It bites (and the gravid female burrows into the flesh of) all warm-blooded animals, including man. Causes lameness, deformities, etc.

Coleoptera

?Drilus sp. A larva of a beetle belonging to the Malacodermata and probably to the genus just named; is armed with poisonous bristles which, when one steps on it with the bare feet, break off and, working through the thick sole into the flesh cause pain, inflammation and even sloughing. The presence of the bristles in the skin can be demonstrated by looking at sections under a low power of the microscope.

Hymenoptera

A large number of wasps (*e. g., Pelopoeus spirifex, Synagris cornuta,* etc.) have painful stings, also ants (*Polyrhachis militaris* Fabr., etc.) Mutillidae (two common species are *Odontomutilla thymele* Pér, and *Barymutilla pythia* Sm.) and bees. Among the latter may be mentioned two giant carpenter bees, *Mesotrichia mixta* Rad. and *Xylocopa tarsata wellmani.* Ckll. These latter not only sting severely, but are also of interest to microscopists in their role of hosts for the remarkable mites belonging to the genus *Greenia* which live in the peculiar pouch which opens on the basal surface of the first abdominal segment of these bees.

In conclusion it should be understood that the foregoing list does not pretend to form a complete report on the human parasites of this district. For I have mentioned only species which I have personally collected and studied and have excluded as being comparatively unimportant nearly as many species as are mentioned in the list. I am afraid that I have given you little more than a bare catalogue of names, but fear of making my paper of unwieldy length has kept me from presenting many interesting details. I hope, however, that the mention of several species not before shown to be human parasites and several not before reported from this part of the world will, at least, be of interest. A list of this kind is necessarily always incomplete and it is my intention to present on some future occasion the result of additional observations. Before closing I must acknowledge my indebtedness to several zoologists, chief among whom is my friend Dr. Walther Horn of Berlin, president of the German Entomological Society.

BIBLIOGRAPHY

My original communications on a number of the species above mentioned may be seen in the transactions of several European scientific societies, chiefly the Deutsche Entomologische Gesellschaft (Berlin), the Société de Médicine et d' Hygiène Tropicales (Paris), and the Società per gli Studi della Malaria (Rome). A large number of notes and articles have also been published in the Journal of Tropical Medicine (London). A few of the most important papers in other journals have the following dates: New York Medical Journal, Aug. 12, 19, 26 and Sept. 2, 1905. Journal of Medical Research, Jan., 1906. Entomological News, Feb., 1906. Journal of Infectious Diseases, Nov. 25, 1905. American Jour. of Medical Sciences, May, 1906. Medicine, July, 1906. Journal of Hygiene (Cambridge, England), July, 1906. Deutsche Medizinische Wochenschrift (Berlin), No. 27, 1906. Polytechnia (Lisbon), No. 5, 1906. Annals and Mag Nat. Hist. (London), p. 242 *et seq.*, 1906. Most of my communications relating to microbiology for several years past have been summarized from time to time in the Bulletin de l' Institut Pasteur and the Archiv für Schiffs-und Tropenhygiene.

Benguella, West Africa.
March 15, 1907.